

A New Paradigm for Supergranulation Derived from Large-Distance Time-Distance

Helioseismology: Pancakes

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With large separations (10-24 deg heliocentric), it has proven possible to cleanly separate the horizontal and vertical components of supergranular flow with time-distance helioseismology. These measurements require very broad filters in the k - ω power spectrum as apparently supergranulation scatters waves over a large area of the power spectrum. By picking locations of supergranulation as peaks in the horizontal divergence signal derived from f-mode waves, it is possible to simultaneously obtain average properties of supergranules and a high signal/noise ratio by averaging over many cells. By comparing ray-theory forward modeling with HMI measurements, an average supergranule model with a peak upflow of 240 m/s at cell center at a depth of 2.3 Mm and a peak horizontal outflow of 700 m/s at a depth of 1.6 Mm. This upflow is a factor of 20 larger than the measured photospheric upflow. These results may not be consistent with earlier measurements using much shorter separations (<5 deg heliocentric). With a 30 Mm horizontal extent and a few Mm in depth, the cells might be characterized as thick pancakes.